Wideband Power Sensor

Models 5012D, 5016D, 5017D, 5018D and 5019D

Operation Manual

Instruction Book Part Number 920-5012S Rev. M

Safety Precautions

The following are general safety precautions that are not necessarily related to any specific part or procedure, and do not necessarily appear elsewhere in this publication. These precautions must be thoroughly understood and apply to all phases of operation and maintenance.

WARNING

Keep Away From Live Circuits

Operating Personnel must at all times observe general safety precautions. Do not replace components or make adjustments to the inside of the test equipment with the high voltage supply turned on. To avoid casualties, always remove power.

WARNING

Shock Hazard

Do not attempt to remove the RF transmission line while RF power is present.

WARNING

Do Not Service Or Adjust Alone

Under no circumstances should any person reach into an enclosure for the purpose of service or adjustment of equipment except in the presence of someone who is capable of rendering aid.

WARNING

Safety Earth Ground

An uniterruptible earth safety ground must be supplied from the main power source to test instruments. Grounding one conductor of a two conductor power cable is not sufficient protection. Serious injury or death can occur if this grounding is not properly supplied.

WARNING

Resuscitation

Personnel working with or near high voltages should be familiar with modern methods of resuscitation.

Safety Symbols

WARNING

Warnings call attention to a procedure, which if not correctly performed, could result in personal injury.

CAUTION

Cautions call attention to a procedure, which if not correctly performed, could result in damage to the instrument.

NOTE

Notes call attention to supplemental information.

Warning Statements

The following safety warnings appear in the text where there is danger to operating and maintenance personnel, and are repeated here for emphasis.

WARNING

Never attempt to connect or disconnect RF equipment from the transmission line while RF power is being applied. Leaking RF energy is a potential health hazard.

On page 2.

Caution Statements

The following equipment cautions appear in the text and are repeated here for emphasis.

Safety Statements

USAGE

ANY USE OF THIS INSTRUMENT IN A MANNER NOT SPECIFIED BY THE MANUFACTURER MAY IMPAIR THE INSTRUMENT'S SAFETY PROTECTION.

USO

EL USO DE ESTE INSTRUMENTO DE MANERA NO ESPECIFICADA POR EL FABRICANTE, PUEDE ANULAR LA PROTECCIÓN DE SEGURIDAD DEL INSTRUMENTO.

BENUTZUNG

WIRD DAS GERÄT AUF ANDERE WEISE VERWENDET ALS VOM HERSTELLER BESCHRIEBEN, KANN DIE GERÄTESICHERHEIT BEEINTRÄCHTIGT WERDEN.

UTILISATION

TOUTE UTILISATION DE CET INSTRUMENT QUI N'EST PAS EXPLICITEMENT PRÉVUE PAR LE FABRICANT PEUT ENDOMMAGER LE DISPOSITIF DE PROTECTION DE L'INSTRUMENT.

IMPIEGO

QUALORA QUESTO STRUMENTO VENISSE UTILIZZATO IN MODO DIVERSO DA COME SPECIFICATO DAL PRODUTTORE LA PROZIONE DI SICUREZZA POTREBBE VENIRNE COMPROMESSA.

SERVICE

SERVICING INSTRUCTIONS ARE FOR USE BY SERVICE - TRAINED PERSONNEL ONLY. TO AVOID DANGEROUS ELECTRIC SHOCK, DO NOT PERFORM ANY SERVICING UNLESS QUALIFIED TO DO SO.

SERVICIO

LAS INSTRUCCIONES DE SERVICIO SON PARA USO EXCLUSIVO DEL PERSONAL DE SERVICIO CAPACITADO. PARA EVITAR EL PELIGRO DE DESCARGAS ELÉCTRICAS, NO REALICE NINGÚN SERVICIO A MENOS QUE ESTÉ CAPACITADO PARA HACERIO.

WARTUNG

ANWEISUNGEN FÜR DIE WARTUNG DES GERÄTES GELTEN NUR FÜR GESCHULTES FACHPERSONAL. ZUR VERMEIDUNG GEFÄHRLICHE, ELEKTRISCHE SCHOCKS, SIND WARTUNGSARBEITEN AUSSCHLIEßLICH VON QUALIFIZIERTEM SERVICEPERSONAL DURCHZUFÜHREN.

ENTRENTIEN

L'EMPLOI DES INSTRUCTIONS D'ENTRETIEN DOIT ÊTRE RÉSERVÉ AU PERSONNEL FORMÉ AUX OPÉRATIONS D'ENTRETIEN. POUR PRÉVENIR UN CHOC ÉLECTRIQUE DANGEREUX, NE PAS EFFECTUER D'ENTRETIEN SI L'ON N'A PAS ÉTÉ QUALIFIÉ POUR CE FAIRE.

ASSISTENZA TECNICA

LE ISTRUZIONI RELATIVE ALL'ASSISTENZA SONO PREVISTE ESCLUSIVAMENTE PER IL PERSONALE OPPORTUNAMENTE ADDESTRATO. PER EVITARE PERICOLOSE SCOSSE ELETTRICHE NON EFFETTUARRE ALCUNA RIPARAZIONE A MENO CHE QUALIFICATI A FARLA.

About This Manual

This manual covers the operating and maintenance instructions for the following models:

5012D	5016D
5017D	5017D-AV
5018D	5019D

Changes to this Manual

We have made every effort to ensure this manual is accurate. If you discover any errors, or if you have suggestions for improving this manual, please send your comments to our Solon, Ohio factory. This manual may be periodically updated. When inquiring about updates to this manual refer to the part number and revision on the title page.

Literature Contents

Chapter Layout

Introduction — Describes the features of the Wideband Power Sensor and Element Types.

Installation — Describes how to connect and install the Wideband Power Sensor into the system that is being monitored.

Operation — Describes how to run and maintain the Wideband Power Sensor.

Specifications — Describes the basic information, settings, and ranges of the Wideband Power Sensor.

Table of Contents

Chapter 1 Introduction

Description

The Bird 5012D, 5016D, 5017D, 5017D-AV, 5018D, and 5019D Wideband Power Sensors (WPS) are Thruline sensors that can measure average, peak, or burst power, VSWR, crest factor, and Complementary Cumulative Distribution Function (CCDF). They can be used with the Bird 5000-NG Digital Power Meter (DPM), Bird Virtual Power Meter (VPM) Software, and the Bird RF Meter Software.

NOTE

Firmware upgrades extending the WPS's capabilities may be periodically released. For the latest firmware upgrade, contact Bird Customer Service at (440) 248-1200 or visit our website at http://www.birdrf.com

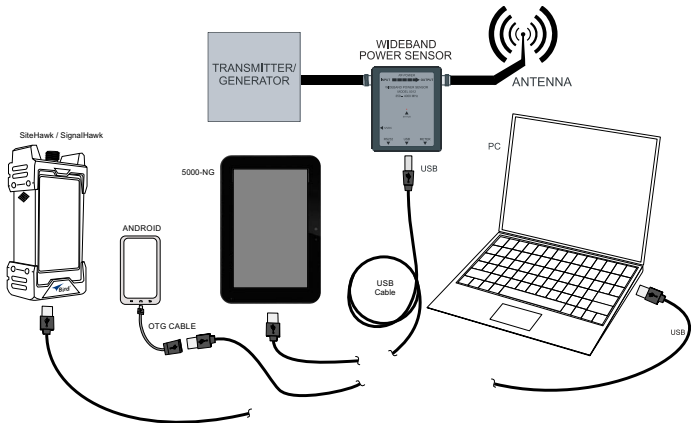
Connections

WARNING

Never attempt to connect or disconnect RF equipment from the transmission line while RF power is being applied. Leaking RF energy is a potential health hazard.

Connect the WPS to the RF line so that the arrow on the sensor points towards the load.

Figure 1 Sensor Connections



5000-NG Digital Power Meter (DPM), SignalHawk, SiteHawk

Connect the WPS to a supported display device using the supplied USB cable.

A separate power supply for the WPS is *not* required when using the DPM, SignalHawk, or SiteHawk.

PC, Virtual Power Meter (VPM) Software

To connect the WPS to a PC running the Virtual Power Meter Software:

Connect the USB cable to the computer and to the WPS. A separate power supply is *not* required when using the USB port.

Bird RF Meter Android App

To connect to an Android device with an OTG port, an adapter may be required.

Zeroing Sensor

Over time, the sensor's "zero value" (reading with no applied RF power) can drift due to environmental factors (temperature, humidity, etc.). This can make the readings performed by this sensor less accurate by the drift value. If the drift would be a significant error, re zero the sensor.

5000-NG

1. Ensure the sensor has reached a stable operating temperature.
2. Ensure no RF power is applied to the sensor.

NOTE

RF power must be turned off before zeroing a power sensor.

3. Tap the Sensor Operation Menu  .
4. Tap the Device Actions item.
5. Tap Zero Cal.
6. Verify no RF is applied to the sensor.
7. Tap OK if no RF is applied.

NOTE

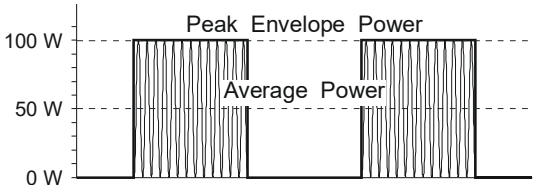
Calibration may take up to 40 seconds. Do not interrupt the calibration. A "Performing Zero Calibration" message will be displayed during the calibration.

Other Devices

To perform a zero calibration using other devices refer to the device's operation manual.

Function Descriptions

Figure 2 Average and Peak Envelope Power - Square Wave Signal



Average Power

Average power is a measure of the equivalent “heating” power of a signal, as measured with a calorimeter. It measures the total RF power in the system, and does not depend on number of carriers or modulation scheme. The WPS is a broadband sensor that measures power across its entire frequency range. Its diodes operate in their ‘square law’ region so that the detector output is directly proportional to the average power, without any additional error correction.

Average power is the most important measurement of any transmission system since the average power is normally specified on the operating license. It is also valuable as a maintenance tool, showing overall system health, and for calibration.

VSWR

VSWR measures the relation between forward and reflected average power. The Bird Wideband Power Sensor calculates the VSWR from the Forward and Reflected Average Power measurements. Rho and Return Loss are also the same measurement, but in different units:

Rho

$$Rho(\rho) = \sqrt{P_R / P_F}$$

VSWR

$$VSWR = \frac{1+\rho}{1-\rho}$$

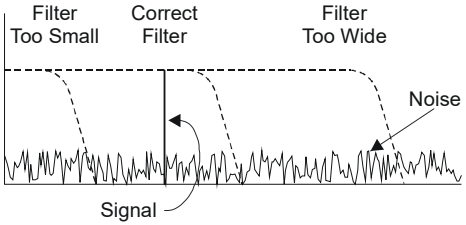
Return Loss (dB)

$$ReturnLoss(dB) = 10\log(P_R / P_F)$$

The health of the feedline and antenna systems can be monitored using VSWR measurement under full power operating conditions. High VSWR is an indicator of feed line damage, overtightened cable or feed line clamps, or antenna changes/damage due to weather conditions, icing, or structural damage to the tower.

Video Filter

Figure 3 Video Filter Settings, 300 kHz Signal



Except for average power and VSWR measurements, all WPS measurements rely on a variable video filter to improve accuracy. This filter can be set to either 4.5 kHz, 400 kHz, or full bandwidth. It should be as narrow as possible while still being larger than the demodulated signal bandwidth (video bandwidth). Narrowing the filter limits the noise contribution caused by interfering signals. Listed below are some common modulation schemes and the appropriate video filter.

Video Filter	Modulation Type
4.5 kHz	CW Burst (Burst width > 150 µs), Voice Band AM, FM, Phase Modulation, Tetra
400 kHz	CW Burst (b.w. > 3 µs), GSM, 50 kHz AM, DQPSK
Full Bandwidth	CW Burst (b.w. > 200 ns), CDMA, WCDMA, DQPSK, DAB/DVB-T

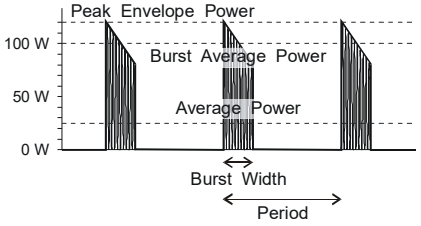
Peak Envelope Power

Peak power measurements detect amplitude changes as a signal modulates the carrier envelope. The WPS operates in an asynchronous cycle: 300 ms of waveform sampling followed by a 50 ms reset period. The peak power is then displayed and the cycle repeats. The display therefore updates about three times per second.

Transmitter overdrive can be detected with peak measurements. Common problems are overshoot at the beginning of burst packets, amplitude modulation, and excessive transients. These damage system components with excessive peak power and also cause data degradation, increasing the Bit Error Rate. For TDMA applications, Peak and Burst Power measurements are used to detect overshoot in single time slots. Other time slots must be turned off for this test.

Burst Average Power

Figure 4 Burst Average Power



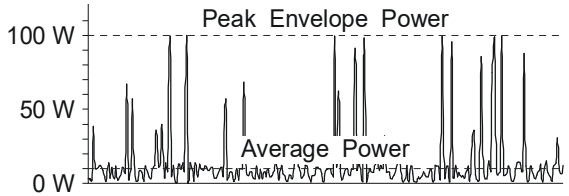
Burst width (BW) is the duration of a pulse. Period (P) is the time from the start of one pulse to the start of the next pulse. Duty cycle (D) is the percentage of time that the transmitter is on. To calculate the duty cycle simply divide the burst width by the period (D = BW / P). Low duty cycles mean that the burst width is much less than the period; a large amount of dead time surrounds each burst. For low duty cycles, the burst average power will be much larger than the average power.

After peak power is measured, a threshold of ½ the peak is set. The sampled power crosses that threshold at the beginning and end of each burst. The time between crossings is used to calculate the duty cycle. Burst Average Power is calculated by dividing the Average Power by the Duty Cycle.

Burst power measurements provide accurate, stable measurements in bursting applications such as TDMA and radar. Accurately measuring the output signal strength is essential for optimizing radar coverage patterns. Actual transmitted power in a single time slot can be deter-mined in TDMA. The other time slots must be off during this test.

Crest Factor

Figure 5 Crest Factor - 10 dB CDMA Signal - 100 W Peak - 10 W Ave

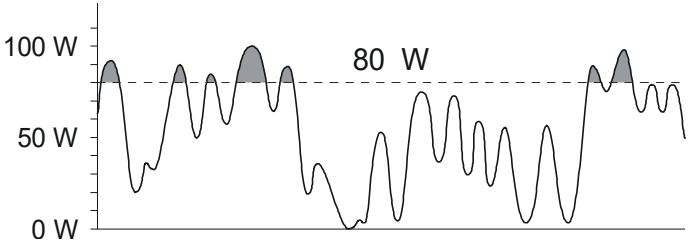


Crest factor (CF) is the ratio of the peak and average powers, in dB. The WPS calculates the Crest Factor from the Forward Peak and Average Power measurements.

Crest factor is becoming one of the most important measurements as communication systems move into the digital age. For CDMA and similar modulation types the CF may reach 10 dB. If the crest factor is too large, the transmitter will not be able to handle the peak powers and amplitude distortion will occur. Crest factor can also detect overdrive and overshoot problems. Knowing the CF allows end-users to more accurately set base station power and lower operating costs.

Complementary Cumulative Distribution Function (CCDF)

Figure 6 CCDF - 100 W Signal - 80 W Threshold - 20% CCDF



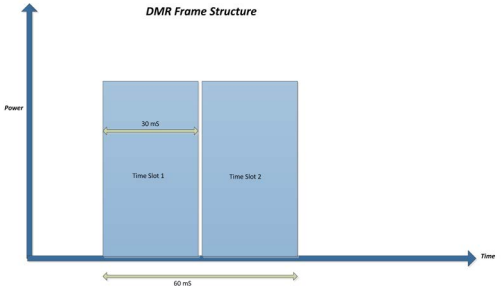
CCDF measures the amount of time the power is above a threshold. Equivalently, it is the probability that any single measurement will be above the threshold. The WPS samples the power over a 300 ms window and compares it to a user-specified threshold, in Watts. The time above the threshold relative to the total time is the CCDF.

CCDF measurements are most useful for pseudo-random signals, such as WCDMA, where a high CCDF means that the transmitter is being overdriven. CCDF can also detect amplitude distortion within an envelope caused by unwanted modulating signals. In TDMA systems, CCDF indicates the health of power amplifier stages and their ability to sustain rated power over an appropriate time frame. As a trouble-shooting aid, CCDF allows tracking of trends such as amplifier overdrive (which can cause dropped calls and high bit error rates).

Low Repetition Rate Waveforms

Many of today's channel access methods involve the use of low repetition frequency time division-multiple access (TDMA) techniques. Examples of these relatively new TDMA formats include Digital Mobile Radio (DMR), and TETRA systems. The DMR format uses an approach where two discrete time slots provide access to a single 25 kHz communication channel, providing the equivalent of 12.S kHz channel bandwidth for the system. The modulation techniques used within these systems vary, from relatively benign forms of frequency shift keying, to more complex quadrature formats such as Quadrature Phase Shift Keying (QPSK).When measuring the power output of transmitters using the DMR format, the base station transmitters will normally transmit with both time slots active, even if there is no traffic on one of the time slots. Under these conditions, it is a simple matter to measure the average power of this continuous waveform. When measuring the output power of subscriber units however, normal operation is to use only one time slot, approximately 30 ms in duration, followed by approximately 30 ms at zero power in the interval where the other time slot would normally be located. The remaining waveform resembles a 30 ms burst, occurring at a 17 Hz repetition rate. Since the measurement of average power under this condition would result in an unstable reading, the correct measurement would be that of burst average power. When making this measurement, the sensor will measure the duty cycle of the signal, as well as the average power, and compute the burst average power of the waveform based upon these parameters.

Figure 7 Low Rep Waveform



Customer Service

Any maintenance or service procedure beyond the scope of those in this chapter should be referred to a qualified service center.

If the unit needs to be returned for any reason, request an Return Material Authorization (RMA) through the Bird Technologies website. All instruments returned must be shipped prepaid and to the attention of the RMA number.

Bird Service Center
30303 Aurora Road
Cleveland (Solon), Ohio 44139-2794
Fax: (440) 248-5426
E-mail: *bsc@birdrf.com*

For the location of the Sales Office nearest you, visit our Web site at:

http://www.birdrf.com

5012D Specifications

Sensor Characteristics

Frequency Range	350 MHz to 4 GHz
RF Power Range	0.15 W to 150 W average, 4W to 400 W peak
Maximum Power	See Figure 9 on page 12.
Impedance, Nominal	50 ohms
Insertion Loss, Max: 0.35 – 1 GHz 1 – 4 GHz	 0.05 dB 0.1 dB
Input VSWR, Max: 0.35 – 2.5 GHz 2.5 – 4 GHz	 1.05 1.10
Directivity, Min: 0.35 – 3 GHz 3 – 4 GHz	 30 dB 28 dB
RF Connectors	N Female
Interface: DPM PC Serial Port PC USB Port	 Male DB-9, EIA-232, 9600 Baud, no parity, 8 data bits, 1 stop bit Female DB-9, EIA-232, 9600 Baud, no parity, 8 data bits, 1 stop bit USB 1.1 interface
Power Supply: DPM USB Port DC Connector	 From host instrument via cable Less than one low-power USB load 7 – 18 Vdc, < 100 mA
Data Logging	In Software

Average Power

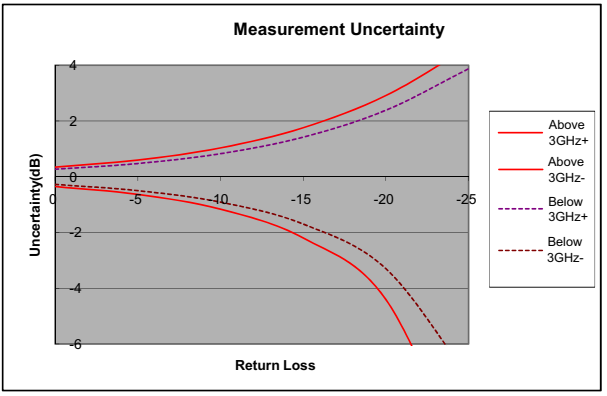
RF Power Range	0.15 – 150 W
Peak/Average Ratio, Max	12 dB
Measurement Uncert.	± (4% of reading ± 0.05 W)†

† Above 35 °C or below 15 °C add 3%

Match Measurement

Measurement Range:	
Return Loss	0 to 23 dB
Rho (ρ)	0.07 to 0.999
VSWR	1.15 to 99.9
Forward Power, Min	.5 W
Measurement Uncert.	See Figure 8 on page 11.

Figure 8 5012D Match Measure Uncertainty



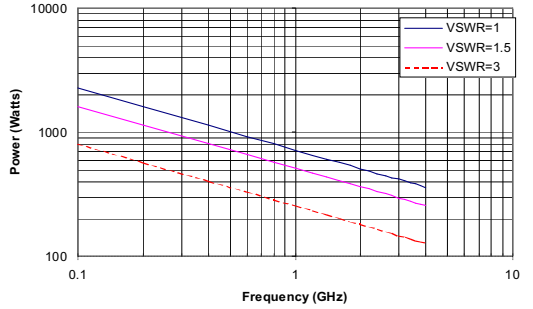
Peak Envelope Power

RF Power Range	4.0 – 400 W†
Measurement Uncert.:	
burst width > 200 µs	± (7% of reading + 0.2 W)††
1 µs < b.w. < 200 µs	± (10% of reading + 0.4 W)††
burst width < 1 µs	± (15% of reading + 0.4 W)††
burst width < 0.5 µs	± (20% of reading + 0.4 W)††
Minimum Pulse Width:	400 ns

† Max. power depends on frequency and system VSWR. See Figure 9 on page 12.

†† Above 35 °C or below 15 °C add 3%
For D < 0.1 add 0.1 W
For period > 0.1s add (1.5% + 0.15 W)

Figure 9 5012D Max. Peak Power



Burst Average Power

Power Range	2 W to 150 W average
Burst Width	1 µs – 5 ms
Repetition Rate, Min	5 Hz (with 12 dB peak / average ratio)
Duty Cycle (D)†	0.02 to 1 (D = Burst Width / Period)
Measurement Uncert.	± (6% of reading + 50/D mW)††

† Duty Cycle and CCDF read out dependent on display method.

†† Above 35 °C or below 15 °C add 3%

Crest Factor

RF Power Range	0.15 to 150 W average, 4 W minimum peak
Measurement Uncert.	Linear sum of peak and average power uncertainty

Complementary Cumulative Distribution Function (CCDF)

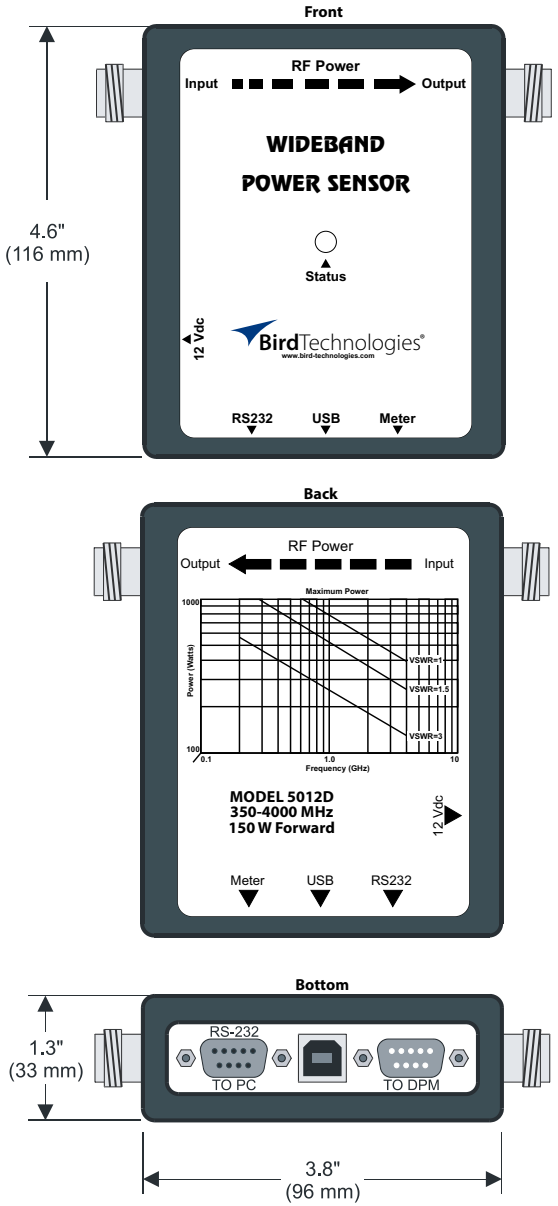
Measurement Range†	0.1 to 100%
Measurement Uncert.	± 2%
Threshold Level Range	2 to 400 W peak
Level Set Accuracy	As peak power uncert. + 2%

† Duty Cycle and CCDF read out dependent on display method.

Physical and Environmental Specifications

Temp, Operating	–10 to +50 °C (+14 to +122 °F)
Temp, Storage	–40 to +80 °C (–40 to +176 °F)
Mechanical Shock and Vibration	MIL-PRF-28800F class 3
Humidity, Max	95% (non-condensing)
Altitude, Max	15,000 ft. (4,500 m)
Dimensions, Nominal	4.75” x 4.6” x 1.3” (121 x 117 x 33 mm)
Weight, Max	1.2 lb. (0.55 kg)
Standards Compliance	CE Compliant. Refer to Declaration of Conformity for specific standards.

Figure 10 5012D WPS



5016D Specifications

Sensor Characteristics

Frequency Range	350 MHz to 4 GHz
RF Power Range	25 mW to 25 W Average, 1W to 60 W peak
Maximum Power	See Figure 12 on page 17.
Impedance, Nominal	50 ohms
Insertion Loss, Max: **0.35 – 1 GHz** **1 – 4 GHz**	 0.05 dB 0.1 dB
Input VSWR, Max: **0.35 – 2.5 GHz** **2.5 – 4 GHz**	 1.05 1.10
Directivity, Min: **0.35 – 3 GHz** **3 – 4 GHz**	 30 dB 28 dB
RF Connectors	N Female
Interface: **DPM** **PC Serial Port** **PC USB Port**	 Male DB-9, RS-232, 9600 Baud, no parity, 8 data bits, 1 stop bit Female DB-9, EIA-232, 9600 Baud, no parity, 8 data bits, 1 stop bit USB 1.1 interface
Power Supply: **DPM** **USB Port** **DC Connector**	 From host instrument via cable less than one low-power USB load 7 – 18 Vdc, < 100 mA
Data Logging	In software

Average Power

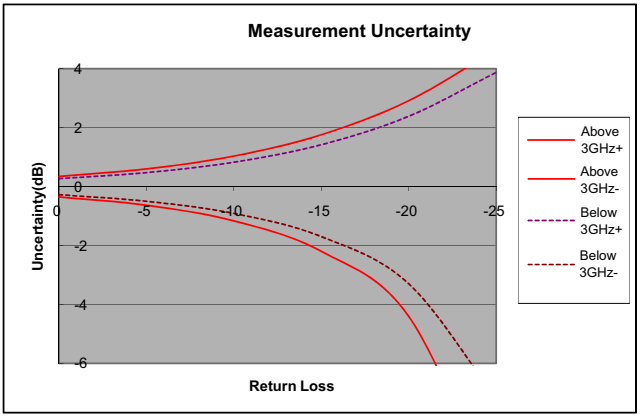
RF Power Range	25 mW to 25 W
Peak/Average Ratio, Max	12 dB
Measurement Uncert.	± (4% of reading + 8 mW)†

† Above 35 °C or below 15 °C add 3%

Match Measurement

Measurement Range:	
Return Loss	0 to 23 dB
Rho (ρ)	007 to 0.999
VSWR	1.15 to 99.9
Forward Power, Min	0.1 W
Measurement Uncert.	See Figure 11 on page 16.

Figure 11 Match Measure Uncertainty



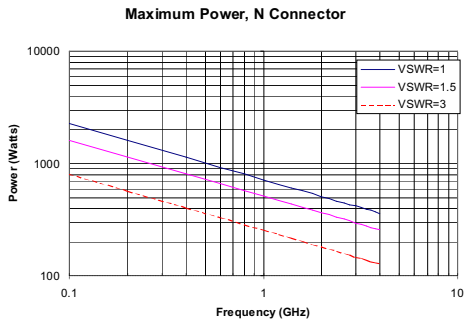
Peak Envelope Power

RF Power Range	1.0 W – 60 W†
Measurement Uncert.:	
burst width > 200 µs	± (7% of reading + 0.05 W)††
1 µs < b.w. < 200 µs	± (10% of reading + 0.1 W)††
burst width < 1 µs	± (15% of reading + 0.1 W)††
burst width < 0.5 µs	± (20% of reading + 0.1 W)††
Minimum Pulse Width:	400 ns

† Max. power depends on frequency and system VSWR. See Figure 12 on page 17.

†† Above 35 °C or below 15 °C add 3%
For D < 0.1 add 0.1 W
For period > 0.1s add (1.5% + 0.15 W)

Figure 12 Max. Peak Power



Burst Average Power

Power Range	1.0 W – 25 W average
Burst Width	1 µs – 5 ms
Repetition Rate, Min	5 Hz (with 12 dB peak/average ratio)
Duty Cycle (D)†	0.02 to 1 (D = Burst Width / Period)
Measurement Uncert.	± (6% of reading + 8/D W)††

† Duty Cycle and CCDF read out dependent on display method.

†† Above 35 °C or below 15 °C add 3%

Crest Factor

RF Power Range	25 mW to 25 W average
Measurement Uncert.	Linear sum of peak and average power uncertainty

Complementary Cumulative Distribution Function (CCDF)

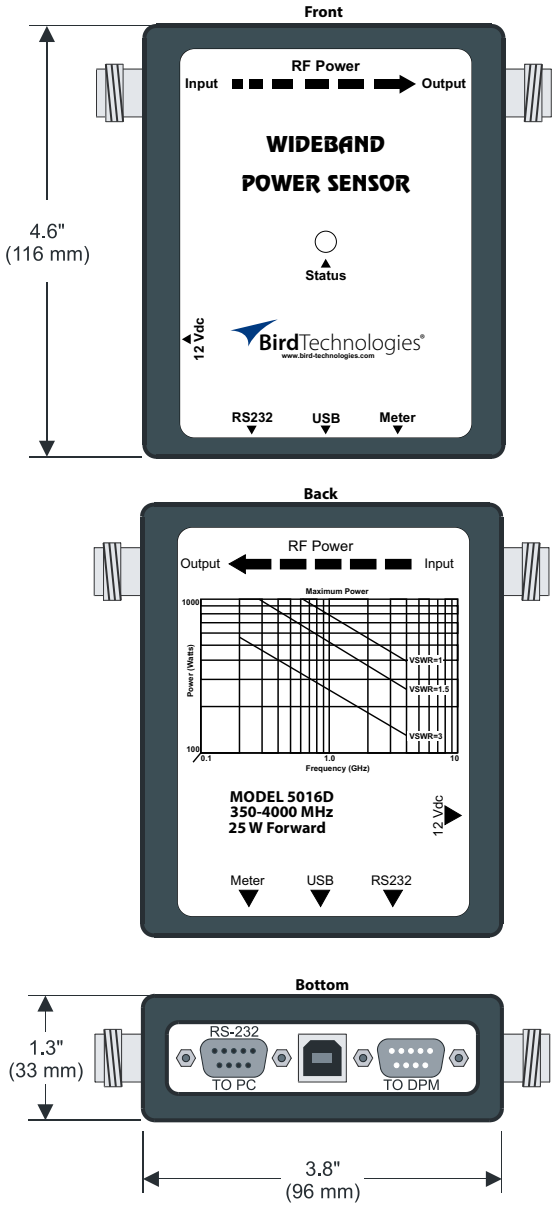
Measurement Range†	0.1 – 100%
Measurement Uncert.	± 2%
Threshold Level Range	25 mW to 60 W
Level Set Accuracy	As peak power uncert. + 2%

† Duty Cycle and CCDF read out dependent on display method.

Physical and Environmental Specifications

Temp, Operating	–10 to +50 °C (+14 to +122 °F)
Temp, Storage	–40 to +80 °C (–40 to +176 °F)
Mechanical Shock and Vibration	MIL-PRF-28800F class 3
Humidity, Max	95% (non-condensing)
Altitude, Max	15,000 ft. (4,500 m)
Dimensions, Nominal	4.75” x 4.6” x 1.3” (121 x 117 x 33 mm)
Weight, Max	1.2 lb. (0.55 kg)
Standards Compliance	CE Compliant. Refer to Declaration of Conformity for specific standards.

Figure 13 5016D WPS



5017D/5017D-AV Specifications

Sensor Characteristics

Frequency Range **5017D** **5017D–AV**	 25 MHz to 1 GHz 100 MHz to 1.3 GHz
RF Power Range †	500 mW to 500 W average, 13.3W to 1300 W peak †
Maximum Power	See Figure 15 on page 22.
Impedance, Nominal	50 ohms
Insertion Loss, Max: **5017D: 25 – 50 MHz** **5017D–AV:** **100 – 1000 MHz** **1000 – 1300 MHz**	 0.05 dB 0.05 dB 0.1 dB
Input VSWR, Max: **5017D: 25 – 1000 MHz** **5017D–AV: 100 – 1300 MHz**	 1.05 1.05
Directivity, Min: **5017D:** **25 – 50 MHz** **51 – 1000 MHz** **5017D-AV:** **100 – 1300 MHz**	 29 dB 30 dB 30 dB
RF Connectors	N Female
Interface: **DPM** **PC Serial Port** **PC USB Port**	 Male DB-9, RS-232, 9600 Baud, no parity, 8 data bits, 1 stop bit Female DB-9, EIA-232, 9600 Baud, no parity, 8 data bits, 1 stop bit USB 1.1 interface
Power Supply: **DPM** **USB Port** **DC Connector**	 From host instrument via cable less than one low-power USB load 7 – 18 Vdc, < 100 mA
Data Logging	In software

† Derate maximum average power rating from 500W at 300MHz to 100W at 1GHz using a straight line on a log-log scale.

Average Power

RF Power Range†	500 mW – 500 W †
Peak/Average Ratio, Max	12 dB
Measurement Uncert.	± (4% of reading + 166 mW)††

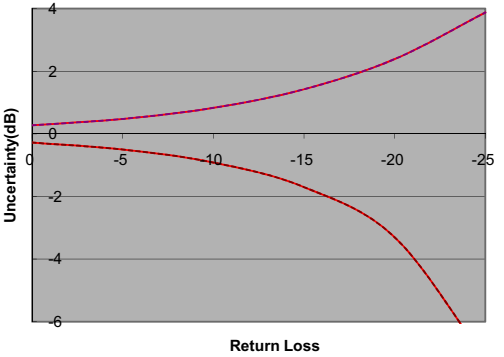
† Derate maximum average power rating from 500W at 300MHz to 100W at 1GHz using a straight line on a log-log scale

†† Above 35 °C or below 15 °C add 3%

Match Measurement

Measurement Range:	
Return Loss	0 to 23 dB
Rho (ρ)	0.07 to 1.0
VSWR	1.15 to 99.9
Forward Power, Min	0.05 W
Measurement Uncert.	See Figure 14 on page 21.

Figure 14 Match Measure Uncertainty



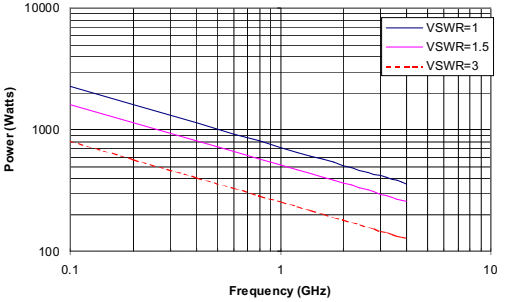
Peak Envelope Power

RF Power Range	13.3 – 1300 W†
Measurement Uncert.:	
burst width > 200 µs	± (7% of reading + 0.7 W)††
1 µs < b.w. < 200 µs	± (10% of reading + 1.4 W)††
burst width < 1 µs	± (15% of reading + 1.4 W)††
burst width < 0.5 µs	± (20% of reading + 1.4 W)††
Minimum Pulse Width:	400 ns

† Max. power depends on frequency and system VSWR. See Figure 15 on page 22.

†† Above 35 °C or below 15 °C add 3%
For D < 0.1 add 0.1 W
For period > 0.1s add (1.5% + 0.15 W)

Figure 15 Max. Peak Power



Burst Average Power

Power Range	13 – 500 W average
Burst Width	1 µs – 5 ms
Repetition Rate, Min	5 Hz (with 12 dB Peak/Avg ratio)
Duty Cycle (D)†	0.02 to 1 (D = Burst Width / Period)
Measurement Uncert.	± (6% of reading + 50/D mW)††

† Duty Cycle and CCDF read out dependent on display method.

†† Above 35 °C or below 15 °C add 3%

Crest Factor

RF Power Range	500 mW to 500 W average, 13.3W minimum peak
Measurement Uncert.	Linear sum of peak and average power uncertainty

Complementary Cumulative Distribution Function (CCDF)

Measurement Range†	0.1 – 100%
Measurement Uncert.	± 2%

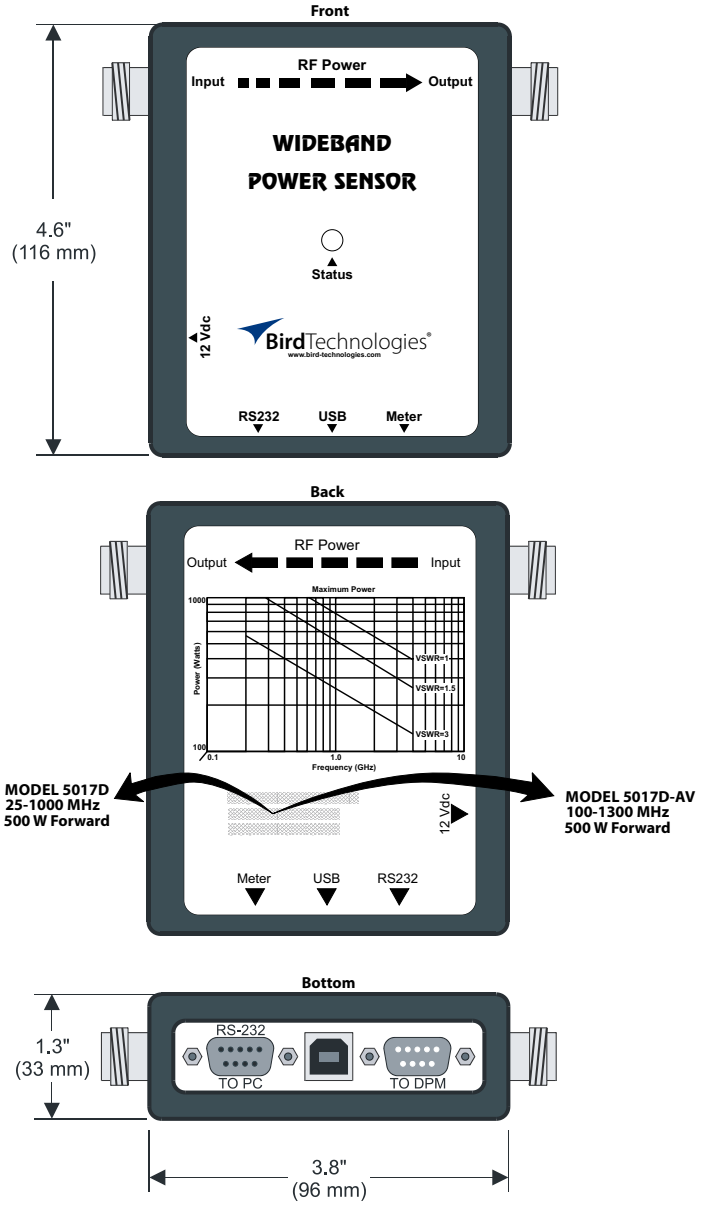
Threshold Level Range	13.0 W to 1300 W peak
Level Set Accuracy	As peak power uncert. + 2%

† Duty Cycle and CCDF read out dependent on display method.

Physical and Environmental Specifications

Temp, Operating	–10 to +50 °C (+14 to +122 °F)
Temp, Storage	–40 to +80 °C (–40 to +176 °F)
Mechanical Shock and Vibration	MIL-PRF-28800F class 3
Humidity, Max	95% (non-condensing)
Altitude, Max	15,000 ft. (4,500 m)
Dimensions, Nominal	4.75” x 4.6” x 1.3” (121 x 117 x 33 mm)
Weight, Max	1.2 lb. (0.55 kg)
Standards Compliance	CE Compliant. Refer to Declaration of Conformity for specific standards.

Figure 16 5017D WPS



5018D Specifications

Sensor Characteristics

Frequency Range	150 MHz to 4.0 GHz
RF Power Range	100 mW to 25 W average, 60 W peak
Maximum Power	See Figure 18 on page 27.
Impedance, Nominal	50 ohms
Insertion Loss, Max: **150 – 1000 MHz** **1000 – 4000 MHz**	 0.05 dB 0.01 dB
Input VSWR, Max: **150 – 2500 MHz** **2500 – 4000 MHz**	 1.05 1.10
Directivity, Min: **150 – 3000 MHz** **3000 – 4000 MHz**	 30 dB 28 dB
RF Connectors	N Female
Interface: **DPM** **PC Serial Port** **PC USB Port**	 Male DB-9, RS-232, 9600 Baud, no parity, 8 data bits, 1 stop bit Female DB-9, EIA-232, 9600 Baud, no parity, 8 data bits, 1 stop bit USB 1.1 interface
Power Supply: **DPM** **USB Port** **DC Connector**	 From host instrument via cable less than one low-power USB load 7 – 18 Vdc, < 100 mA
Data Logging	In software

Average Power

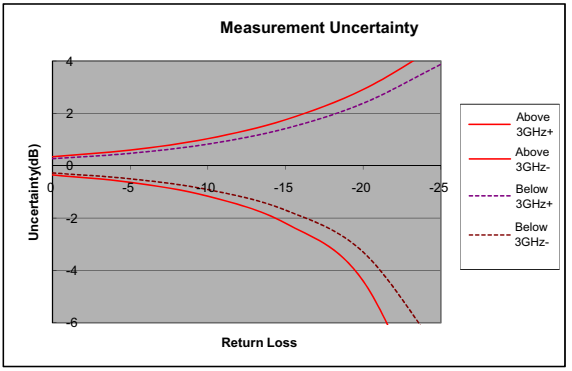
RF Power Range	25 mW – 25 W
Peak/Average Ratio, Max	12 dB
Measurement Uncert.	± (4% of reading + 0.008 mW)†

† Above 35 °C or below 15 °C add 3%

Match Measurement

Measurement Range:	
Return Loss	0 to 23 dB
Rho (ρ)	0.07 to 1.0
VSWR	1.15 to 99.9
Forward Power, Min	0.1 W
Measurement Uncert.	See Figure 17 on page 26.

Figure 17 Match Measure Uncertainty



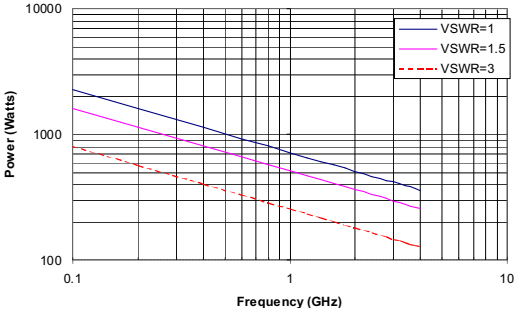
Peak Envelope Power

RF Power Range	4 – 60 W†
Measurement Uncert.:	
burst width > 200 µs	± (7% of reading + 0.05 W)††
1 µs < b.w. < 200 µs	± (10% of reading + 0.1 W)††
burst width < 1 µs	± (15% of reading + 0.1 W)††
burst width < 0.5 µs	± (20% of reading + 0.1 W)††
Minimum Pulse Width:	400 ns

† Max. power depends on frequency and system VSWR. See Figure 18 on page 27.

†† Above 35 °C or below 15 °C add 3%
For D < 0.1 add 0.1 W
For period > 0.1s add (1.5% + 0.15 W)

Figure 18 Max. Peak Power



Burst Average Power

Power Range	25 mW – 25 W average
Burst Width	1 µs – 5 ms
Repetition Rate, Min	5 Hz (with 12 dB Peak/Avg ratio)
Duty Cycle (D)†	0.02 to 1 (D = Burst Width / Period)
Measurement Uncert.	± (6% of reading + 0.008/D W)††

† Duty Cycle and CCDF read out dependent on display method.

†† Above 35 °C or below 15 °C add 3%

Crest Factor

RF Power Range	25 mW to 25 W
Measurement Uncert.	Linear sum of peak and average power uncertainty

Complementary Cumulative Distribution Function (CCDF)

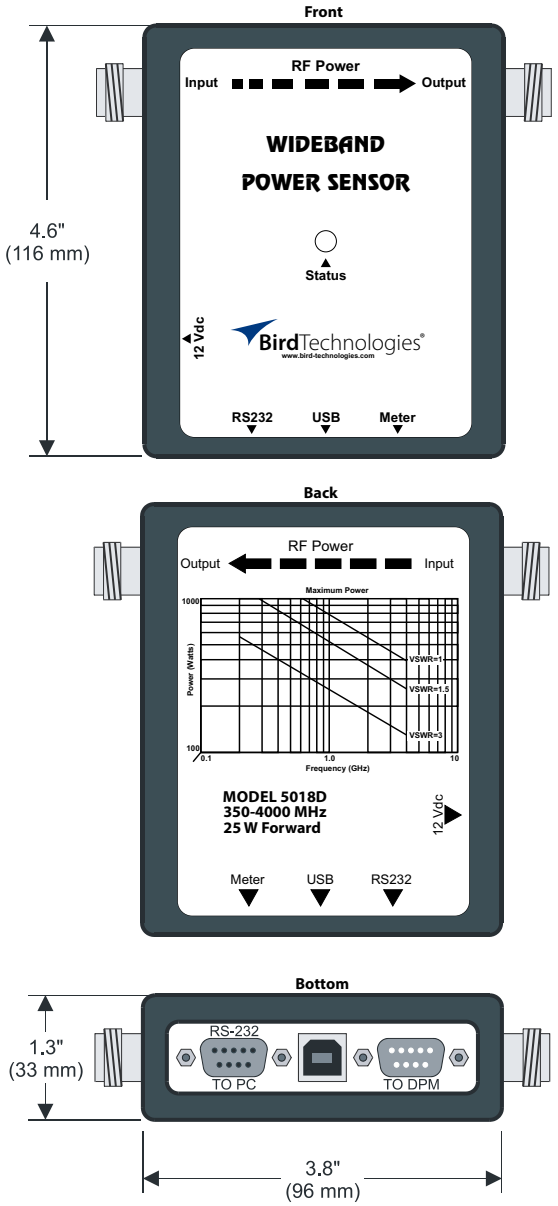
Measurement Range†	0.1 – 100%
Measurement Uncert.	± 2%
Threshold Level Range	25 mW to 60 W
Level Set Accuracy	As peak power uncert. + 2%

† Duty Cycle and CCDF read out dependent on display method.

Physical and Environmental Specifications

Temp, Operating	–10 to +50 °C (+14 to +122 °F)
Temp, Storage	–40 to +80 °C (–40 to +176 °F)
Mechanical Shock and Vibration	MIL-PRF-28800F class 3
Humidity, Max	95% (non-condensing)
Altitude, Max	15,000 ft. (4,500 m)
Dimensions, Nominal	4.75” x 4.6” x 1.3” (121 x 117 x 33 mm)
Weight, Max	1.2 lb. (0.55 kg)
Standards Compliance	CE Compliant. Refer to Declaration of Conformity for specific standards.

Figure 19 5018D WPS



5019D Specifications

Sensor Characteristics

Frequency Range	25 MHz to 1.0 GHz
RF Power Range	100 mW to 100 W average, 2.6 to 260 W peak
Maximum Power	See Figure 21 on page 32.
Impedance, Nominal	50 ohms
Insertion Loss, Max: **25 – 1000 MHz**	 0.05 dB
Input VSWR, Max: **25 – 1000 MHz**	 1.05
Directivity, Min: **25 – 100 MHz** **100 – 1000 MHz**	 28 dB 30 dB
RF Connectors	N Female
Interface: **DPM** **PC Serial Port** **PC USB Port**	 Male DB-9, RS-232, 9600 Baud, no parity, 8 data bits, 1 stop bit Female DB-9, EIA-232, 9600 Baud, no parity, 8 data bits, 1 stop bit USB 1.1 interface
Power Supply: **DPM** **USB Port** **DC Connector**	 From host instrument via cable less than one low-power USB load 7 – 18 Vdc, < 100 mA
Data Logging	In software

Average Power

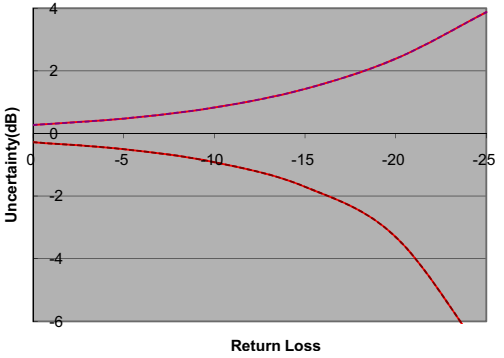
RF Power Range	100 mW – 100 W
Peak/Average Ratio, Max	12 dB
Measurement Uncert.	± (4% of reading + 166 mW)†

† Above 35 °C or below 15 °C add 3%

Match Measurement

Measurement Range:	
Return Loss	0 to 23 dB
Rho (ρ)	0.07 to 1.0
VSWR	1.15 to 99.9
Forward Power, Min	0.3 W
Measurement Uncert.	See Figure 20 on page 31.

Figure 20 Match Measure Uncertainty



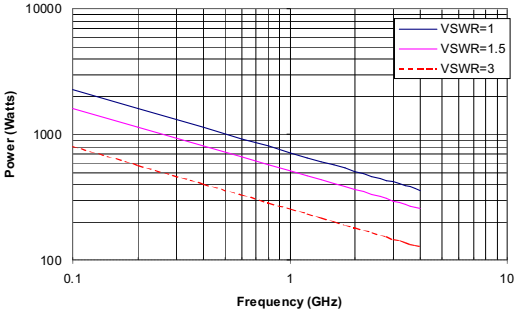
Peak Envelope Power

RF Power Range	2.6 – 260 W†
Measurement Uncert.:	
burst width > 200 µs	± (7% of reading + 0.7 W)††
1 µs < b.w. < 200 µs	± (10% of reading + 1.4 W)††
burst width < 1 µs	± (15% of reading + 1.4 W)††
burst width < 0.5 µs	± (20% of reading + 1.4 W)††
Minimum Pulse Width:	400 ns

† Max. power depends on frequency and system VSWR. See Figure 21 on page 32.

†† Above 35 °C or below 15 °C add 3%
For D < 0.1 add 0.1 W
For period > 0.1s add (1.5% + 0.15 W)

Figure 21 Max. Peak Power



Burst Average Power

Power Range	2.6 – 100 W average
Burst Width	1 µs – 5 ms
Repetition Rate, Min	5 Hz (with 12 dB Peak/Avg ratio)
Duty Cycle (D)†	0.02 to 1 (D = Burst Width / Period)
Measurement Uncert.	± (6% of reading + 166/D mW)††

† Duty Cycle and CCDF read out dependent on display method.

†† Above 35 °C or below 15 °C add 3%

Crest Factor

RF Power Range	100 mW to 100 W average, 2.6 W minimum peak
Measurement Uncert.	Linear sum of peak and average power uncertainty

Complementary Cumulative Distribution Function (CCDF)

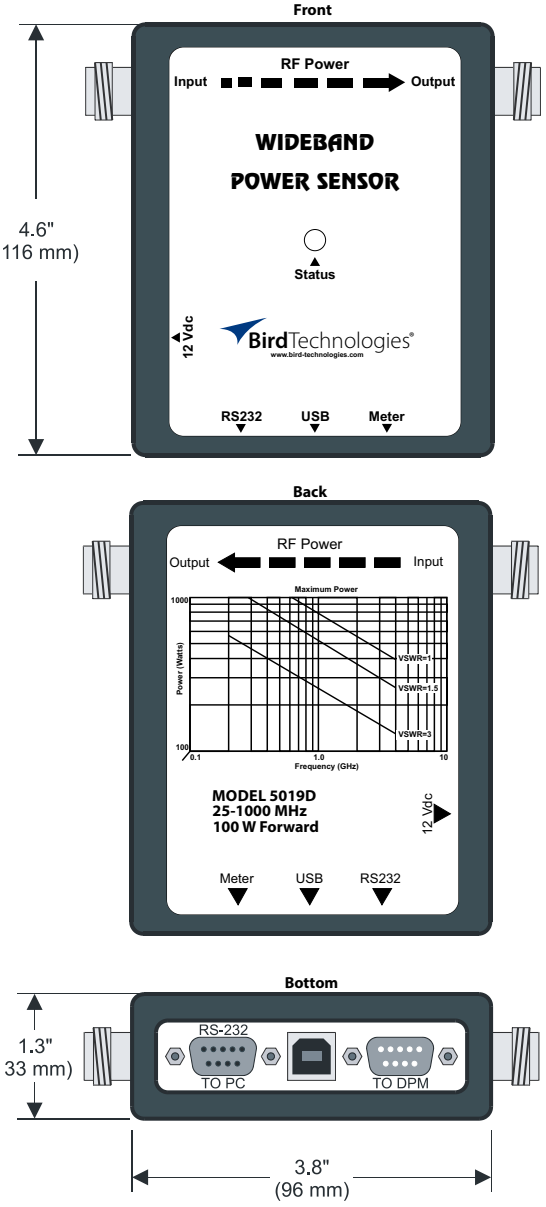
Measurement Range†	0.1 – 100%
Measurement Uncert.	± 2%
Threshold Level Range	2.6 W to 260 W peak
Level Set Accuracy	As peak power uncert. + 2%

† Duty Cycle and CCDF read out dependent on display method.

Physical and Environmental Specifications

Temp, Operating	–10 to +50 °C (+14 to +122 °F)
Temp, Storage	–40 to +80 °C (–40 to +176 °F)
Mechanical Shock and Vibration	MIL-PRF-28800F class 3
Humidity, Max	95% (non-condensing)
Altitude, Max	15,000 ft. (4,500 m)
Dimensions, Nominal	4.75” x 4.6” x 1.3” (121 x 117 x 33 mm)
Weight, Max	1.2 lb. (0.55 kg)
Standards Compliance	CE Compliant. Refer to Declaration of Conformity for specific standards.

Figure 22 5019D WPS



Limited Warranty

All products manufactured by Seller are warranted to be free from defects in material and workmanship for a period of one (1) year, unless otherwise specified, from date of shipment and to conform to applicable specifications, drawings, blueprints and/or samples. Seller's sole obligation under these warranties shall be to issue credit, repair or replace any item or part thereof which is proved to be other than as warranted; no allowance shall be made for any labor charges of Buyer for replacement of parts, adjustment or repairs, or any other work, unless such charges are authorized in advance by Seller.

If Seller's products are claimed to be defective in material or workmanship or not to conform to specifications, drawings, blueprints and/or samples, Seller shall, upon prompt notice thereof, either examine the products where they are located or issue shipping instructions for return to Seller (transportation-charges prepaid by Buyer). In the event any of our products are proved to be other than as warranted, transportation costs (cheapest way) to and from Seller's plant, will be borne by Seller and reimbursement or credit will be made for amounts so expended by Buyer. Every such claim for breach of these warranties shall be deemed to be waived by Buyer unless made in writing within ten (10) days from the date of discovery of the defect.

The above warranties shall not extend to any products or parts thereof which have been subjected to any misuse or neglect, damaged by accident, rendered defective by reason of improper installation or by the performance of repairs or alterations outside of our plant, and shall not apply to any goods or parts thereof furnished by Buyer or acquired from others at Buyer's request and/or to Buyer's specifications. Routine (regularly required) calibration is not covered under this limited warranty. In addition, Seller's warranties do not extend to the failure of tubes, transistors, fuses and batteries, or to other equipment and parts manufactured by others except to the extent of the original manufacturer's warranty to Seller.

The obligations under the foregoing warranties are limited to the precise terms thereof. These warranties provide exclusive remedies, expressly in lieu of all other remedies including claims for special or consequential damages. SELLER NEITHER MAKES NOR ASSUMES ANY OTHER WARRANTY WHATSOEVER, WHETHER EXPRESS, STATUTORY, OR IMPLIED, INCLUDING WARRANTIES OF MERCHANTABILITY AND FITNESS, AND NO PERSON IS AUTHORIZED TO ASSUME FOR SELLER ANY OBLIGATION OR LIABILITY NOT STRICTLY IN ACCORDANCE WITH THE FOREGOING.